STIC Search Report
EIC 2800

USPTO

TO: Monica Lewis Location: JEF 5A30 Art Unit : 2822 Monday, March 15, 2004 Case Serial Number: 09/981277	From: Scott Hertzog Location: EIC 2800 JEF4B68 Phone: 272-2663 Scott.hertzog@uspto.gov

Search Notes

Examiner Lewis,

Attached are edited first pass search results from the patent and nonpatent databases.

Colored tags indicate abstracts especially worth your review.

If you need further searching or have questions or comments, please let me know.

Thanks,
Scott Hertzog

sira
Search and Information
Resources Administration

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          FILE 'HCAPLUS, INSPEC' ENTERED AT 13:56:27 ON 15 MAR 2004
L1            9723 S SPIN(2A) VALVE# OR MTJ OR (MAGNET? OR FERROMAGNET?)(2A) TUNNEL?
L2           63078 S (SHAP#### OR TOPOG#####)(3A) SURFACE#
L3          645014 S PLANAR? OR TRUNCATE? OR MESA# OR TABLE OR
                     TABLES OR TABLETOP# OR FLAT##### OR ROUND######
L4         1304663 S PEAK# OR CRAG### OR COLUMN### OR POST# OR PINNACLE# OR CREST#### OR
                      (GRAIN? OR NANOGRAIN? OR MICROGRAIN?) (2A)(ANGLE# OR ANGULAR####)
L5           48387 S (ION OR SPUTTER?)(2A)(ETCH#### OR MILL####)
L6            6646 S (FERROMAGNET? OR FM)(2A) COUPL?
L7             836 S FLAT?(3A) PEAK?
L8             958 S L1 AND (L2 OR L3 OR L4)
L9               0 S L8 AND L7
L10             38 S L8 AND (L5 OR L6)
L11             28 DUP REM L10 (10 DUPLICATES REMOVED)
L12          12848 S SDT OR (SPIN(A) DEPEND#####)(A) TUNNEL####
                     OR TMR OR TUNNEL#####(2A)(FERROMAGNET? OR MAGNET?) OR GMR
L13           1085 S MRAM OR (FERROMAGNET? OR MAGNET########)(5A)(RAM OR RANDOM(A)ACCESS)
L14           2039 S (MAGNET? OR FERROMAGNET?)(L)(MEMORY DEVICE#)/CT
L15           1480 S (L12 OR L13 OR L14) AND (ROUGH? OR SMOOTH?
                     OR WAVE? OR WAVINESS OR WAVYNESS)
L16             85 S L15 AND (L5 OR L6)
L17             78 S L16 NOT L11
L18             54 DUP REM L17 (24 DUPLICATES REMOVED)
L19             38 S L18 NOT PY>2001
L20           1063 S L1 AND (ROUGH? OR SMOOTH? OR WAVE? OR WAVINESS OR WAVYNESS)
L21             76 S L20 AND (L5 OR L6)
L22             23 S L21 NOT L11 NOT L16
L23             17 S L22 NOT PY>2001
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          FILE 'HCAPLUS' ENTERED AT 11:17:14 ON 15 MAR 2004
L1         31255 S SDT OR (SPIN(A)DEPEND#####)(A)TUNNEL####
                 OR TMR OR TUNNEL#####(2A)?MAGNET? OR GMR OR ?MAGNET?(3A)RESIST?
L2          2072 S ?MAGNET?(L)(MEMORY DEVICE#)/CT
L3         16937 S (SHAP#### OR TOPOG#####)(3A)SURFACE#
L4        364366 S PLANAR? OR TRUNCATE? OR MESA# OR TABLE OR
                 TABLES OR TABLETOP# OR FLAT##### OR ROUND###### FLAT? OR
                 TRUNCAT?
L5       1008091 S PEAK# OR CRAG### OR COLUMN### OR POST# OR
                 PINNACLE# OR CREST#### OR ?GRAIN?(2A)(ANGLE# OR ANGULAR####)
L6         26708 S (ION OR SPUTTER?)(2A)(ETCH#### OR MILL####)
L7          4085 S (FERROMAGNET? OR FM)(2A)COUPL?
L8         33094 S (L1 OR L2)
L9          2373 S L8 AND (L3 OR L4 OR L5)
L10          491 S FLAT?(3A)PEAK?
L11            1 S L9 AND L10
L12            1 S L10 AND L1
L13          392 S L1 AND (L6 OR L7)
L14            5 S L1 AND L6 AND L7
L15            5 DUP REM L14 (0 DUPLICATES REMOVED)
L16           45 S L9 AND (L6-L7)
L17           45 DUP REM L16 (0 DUPLICATES REMOVED)
L18           45 S L17
L19           23 S L17 NOT P/DT NOT PY>2001
L20            6 S L18 AND (WO OR US)/PRC(S)PRD<20011017
L21            1 S L18 NOT L20 NOT PD.B>20011017 NOT L19
L22           30 S L19-L21
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            FILE 'INSPEC' ENTERED AT 11:50:45 ON 15 MAR 2004
L1          5522 S SDT OR (SPIN(A)DEPEND#####) (A)TUNNEL####
                 OR TMR OR TUNNEL#####(2A) (FERROMAGNET? OR MAGNET?) OR GMR
L2           458 S MRAM OR (FERROMAGNET? OR MAGNET########) (5A) (RAM OR RANDOM(A)ACCESS)
L3         46141 S (SHAP#### OR TOPOG#####) (3A)SURFACE#
L4        249174 S PLANAR? OR TRUNCATE? OR MESA# OR TABLE OR TABLES OR TABLETOP# OR
                 FLAT#### OR ROUND######
L5        296711 S PEAK# OR CRAG### OR COLUMN### OR POST# OR PINNACLE# OR CREST#### OR
                 (GRAIN? OR NANOGRAIN? OR MICROGRAIN?) (2A) (ANGLE# OR ANGULAR####)
L6         21679 S (ION OR SPUTTER?) (2A) (ETCH#### OR MILL####)
L7          2561 S (FERROMAGNET? OR FM) (2A)COUPL?
L8           345 S FLAT?(3A)PEAK?
L9          5809 S (L1 OR L2)
L10          635 S L9 AND (L3 OR L4 OR L5)
L11           30 S L10 AND (L6 OR L7)
L12            1 S L8 AND L9
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L19 ANSWER 1 OF 38   HCAPLUS   COPYRIGHT 2004 ACS on STN
AN   2002:303558 HCAPLUS DN   136:349548
TI   Induced domain movement in **magnetic tunnel** junctions
     with sine-shaped small field modulations
AU   Schmitz, Rolf
SO   Berichte des Forschungszentrums Juelich (2001), Juel-3925, i-v, 1-124
     CODEN: FJBEE5; ISSN: 0366-0885

AB   First measurements on Barkhausen noise from **magnetic tunnel** junctions are
presented. A low frequency magnetic field was applied to the magnetic thin film
layers and then the temporary changes in the voltage signal of the junction were
measured as spectral noise d. The alternating magnetic field causes a temporary
change of the magnetization in the ferromagnetic layers. These changes influence the
behavior of the resistance directly and the **TMR**-effect, resp. With this method it was
possible to draw conclusions on the switching behavior of the magnetic domains in each
magnetic layer. **Magnetic tunnel** junctions with a trilayer system made of
Co/Al2O3/NiFe were fabricated. The Al2O3 barrier was fabricated using a Hg-low
pressure lamp which was able to produce O radicals as well as O3 from pure O2 gas.
This successful preparation method is concerned to be an alternative to the commonly
used plasma oxidation All of the tunnel junctions showed a clear tunneling behavior
based on the nonlinear current-voltage characteristics. The **tunneling
magnetoresistance** effect of the junctions made with the UV-light were in the range of
10-20% at room temperature The magnetic switching fields were measured to 0.5 and 2
kA/m for the soft- and hard magnetic layers resp. To characterize the tunnel barrier,
noise measurements at different applied magnetic fields were made. No significant
changes were observed in the spectra of the UV-light oxidized and the plasma oxidized
tunnel junctions. The surface **roughness** of Co and Al were also studied by x-ray
diffraction and scanning force microscopy measurements. These showed clearly that a
low Ar pressure during sputtering is responsible for the excellent **smoothness**. An rms-
roughness was found which was less than 0.2 nm. **TMR** ratios of the UV-light oxidized
barriers were investigated depending on the bias-voltage and temperature Furthermore,
the O2 pressure was varied which was applied during the 1-h oxidation procedure of the
Al. An optimal condition could be found at p = 10 mbar O2. Using this value the
maximum **TMR**-ratios were received.

L19   ANSWER 12 OF 38 HCAPLUS COPYRIGHT 2004 ACS on STN
AN   2001:187424 HCAPLUS DN   134:260268
TI   Effects of annealing on the microstructure and giant magnetoresistance (**GMR**) of
      Co-Cu-based spin valves
AU   Mangan, M. A.; Spanos, G.; McMichael, R. D.; Chen, P. J.; Egelhoff, W. F.,Jr.
CS   Naval Research Laboratory, Washington, DC, USA
SO   Metallurgical and Materials Transactions A: Physical Metallurgy and
      Materials Science (2001), 32A(3), 577-584
      CODEN: MMTAEB; ISSN: 1073-5623
PB   Minerals, Metals & Materials Society

AB   The effect of annealing on the microstructure and giant magnetoresistive
      properties of NiO/Co/Cu/Co bottom spin valves was studied by conventional and
      high-resolution TEM. The value of the **GMR** of these spin valves decreases from
      12.2 to 2.7% after annealing in a vacuum for 30 min at 335°. This decrease is
      attributed to an increase in the **roughness** of the Co and Cu layers. In annealed
      specimens, grain boundary grooving is also observed in the antiferromagnetic NiO
      pinning layer at the NiO/Co interface, and the location of these grooves
      correlates with **waviness** in the Co/Cu interfaces. An increase in the Neel orange
      peel **coupling** between the **ferromagnetic** Co layers, resulting from the increased
      roughness of the Co/Cu interfaces, accompanies the degradation of the **GMR**.

L19   ANSWER 14 OF 38   HCAPLUS   COPYRIGHT 2004 ACS on STN
AN   2000:231230 HCAPLUS DN   132:317108
TI   Nature of coupling and origin of coercivity in giant magnetoresistance
      NiO-Co-Cu-based spin valves
AU   Chopra, Harsh Deep; Yang, David X.; Chen, P. J.; Parks, D. C.; Egelhoff,
      W. F., Jr.
SO   Physical Review B: Condensed Matter and Materials Physics (2000), 61(14),
      9642-9652
      CODEN: PRBMDO; ISSN: 0163-1829
AB   The effect of various couplings on the switching field and coercivity in NiO-Co-
      Cu-based giant magnetoresistance (**GMR**) bottom spin valves is investigated.
      Bottom spin valves as well as different layer permutations that make up a bottom
      spin valve, viz., Co single films, Co/Cu/Co trilayers, and Co/NiO bilayers
      (deposited under similar growth conditions), were investigated for their
      magnetic, crystal, and interfacial structure. As-deposited bottom spin valves
      exhibit a large **GMR** of ≈16.5%, and a small net **ferromagnetic coupling** (+0.36 mT)
      between the "free" Co layer and the NiO-pinned Co layer. The high resolution
      transmission electron microscopy (HRTEM) and in situ scanning tunneling
      microscopy (STM) studies on spin valves and trilayers show that the average grain
      size in these films is ≈20 nm and average **roughness** ≈ 0.3 nm. Using these
      values, the observed **ferromagnetic coupling** in spin valves could largely be
      accounted for by Neel's so-called "orange-peel" coupling. Results also show that
      the "free" Co layer exhibits an enhanced coercivity (HcFree-Co=6.7 mT) with
      respect to Co single films of comparable thickness (HcCo=2.7 mT). The TEM
      studies did not reveal the presence of any pin-holes, and "orange-peel" or
      oscillatory exchange coupling mechanisms cannot adequately account for this
      observed coercivity enhancement in the "free" Co layer of spin valves. The
      present study shows that the often observed and undesirable coercivity
      enhancement in the "free" Co layer results from magnetostatic coupling between
      domain walls in the "free" Co layer and high coercivity NiO-pinned Co layer
      (HcPinned-Co≈45 mT); without NiO, the coercivity of Co layers in the
      corresponding Co/Cu/Co trilayer remains largely unchanged (HcCo/Cu/Co=3.0 mT)
      with respect to Co single films. Evidence of magnetostatically coupled domain
      walls was confirmed by direct observation of magnetization reversal, which
      revealed that domain walls in the "free" Co layer are magnetostatically locked-in
      with stray fields due to domain walls or magnetization ripples in the high
      coercivity NiO-pinned Co layer of the spin valves. The observed escape fields
      (defined as fields in excess of intrinsic coercivity of Co single film that are
      required to overcome magnetostatic coupling between domain walls) are in
      agreement with theor. calculated values of escape fields.

STIC-EIC 2800   Jef4-A58   Scott Hertzog   571-272-2663

L11   ANSWER 14 OF 28   HCAPLUS   COPYRIGHT 2004 ACS on STN DUPLICATE 7
AN   2001:249332   HCAPLUS DN   135:39902
TI   Effects of oxide seed and cap layers on magnetic properties of a synthetic
      spin valve
AU   Lin, Tsann; Mauri, Daniele
SO   Applied Physics Letters (2001), 78(15), 2181-2183
      CODEN: APPLAB; ISSN: 0003-6951
AB   A synthetic **spin valve** comprising Al2O3/Ni-Cr-Fe/Ni- Fe/Pt-Mn/Co-Fe/Ru/Co-
      Fe/Cu/Co-Fe/Ni-Fe/Cu/Al2O3/Ta films was annealed and evaluated as a read sensor
      for ultrahigh-d. (≥20 Gb/in.2) recording. The Al2O3 film used as its oxide seed
      layer provides an in situ **flat** surface for the Pt-Mn, Co-Fe, and Ni-Fe films to
      develop strong {111} crystalline textures, thereby increasing its giant
      magnetoresistance coefficient to as high as 13.8%. Another Al2O3 film used as
      its oxide cap layer protects the Co-Fe/Ni-Fe sense layers from interface mixing
      and O interdiffusion, thus improving the soft magnetic properties and thermal
      stability of the sense layers. Antiferromagnetic/ **ferromagnetic coupling** between
      the Pt-Mn pinning and Co-Fe/Ru/Co-Fe synthetic pinned layers is strong and
      thermally stable enough for proper sensor operation. **Ferromagnetic/**
      ferromagnetic coupling across the Cu spacer layer is antiparallel, and hence it
      is feasible to achieve optimal biasing of magnetoresistance responses. This
      synthetic **spin valve** is sandwiched into a read gap 0.1 μm in thickness, and is
      patterned and lapped into a read sensor 0.42 and 0.23 μm in phys. width and
      height, resp. With a sense current of 4 mA, this read sensor exhibits an
      effective read width of 0.31 μm, stable magnetoresistance responses, and signal
      sensitivity of 6.64 mV/μm.
IT   Coercive force (magnetic)
      Ferromagnetic exchange
      Giant magnetoresistance
      Magnetic moment
      Magnetoresistance
        Spin valves
          (effects of oxide seed and cap layers on magnetic properties of
          synthetic **spin valve** comprising
          Al2O3/Ni-Cr-Fe/Ni-Fe/Pt-Mn/Co-Fe/Ru/Co-Fe/Cu/Co-Fe/Ni-Fe/Cu/Al2O3/Ta
          films)
IT   1344-28-1, Alumina, properties   7440-18-8, Ruthenium, properties
      7440-25-7, Tantalum, properties   7440-50-8, Copper, properties
      11148-32-6   12649-48-8   12781-95-2   77088-24-5
      RL: DEV (Device component use); PEP (Physical, engineering or chemical
      process); PRP (Properties); PROC (Process); USES (Uses)
          (effects of oxide seed and cap layers on magnetic properties of
          synthetic **spin valve** comprising
          Al2O3/Ni-Cr-Fe/Ni-Fe/Pt-Mn/Co-Fe/Ru/Co-Fe/Cu/Co-Fe/Ni-Fe/Cu/Al2O3/Ta
          films)   .

L11   ANSWER 18 OF 28 HCAPLUS   COPYRIGHT 2004 ACS on STN DUPLICATE 9
AN   1999:263545 HCAPLUS Full-text
TI   Effect of finite magnetic film thickness on Neel coupling in **spin valves**
AU   Kools, J. C. S.; Kula, W.; Mauri, Daniele; Lin, Tsann
SO   Journal of Applied Physics (1999), 85(8, Pt. 2A), 4466-4468
      CODEN: JAPIAU; ISSN: 0021-8979
AB   **Spin valves** are widely studied due to their application as magnetoresistive
      material in magnetic recording heads and other magnetic field sensors.   An
      important film property is the interlayer coupling field (called offset field Ho
      or **ferromagnetic coupling** field Hf).   It has been shown that the Neel model for
      orange-peel coupling can be applied successfully to describe this interlayer
      coupling.   The waviness associated with the developing granular structure is
      thereby taken as the relevant waviness.   The original Neel model describes the
      ferromagnetic magnetostatic interaction between two ferromagnetic layers, of
      infinite thickness, separated by a nonmagnetic spacer with a correlated interface
      waviness.   In this article, this phys. picture is refined to account for the
      effect of the finite thickness of the magnetic films in a **spin valve**.   Magnetic
      poles created at the outer surfaces of the magnetic layers result in an
      antiferromagnetic interaction with the poles at the inner surface of the opposite
      layer.   A simple model is presented for the different interactions in a top **spin
      valve** (**columnar** structure with cumulative waviness on a **flat** substrate) and for a
      bottom **spin valve** (**columnar** structure with conformal waviness on a way
      substrate).   Comparison to exptl. data, shows that the free and pinned layer
      thickness dependence can be understood from this refined picture.

L11 ANSWER 26 OF 28 INSPEC   (C) 2004 IEE on STN
AN   1995:4942890 INSPEC   DN A9511-6865-009 Full-text
TI   Effect of energetic particle bombardment during sputter deposition on the
     properties of exchange-biased **spin-valve** multilayers.
AU   Kools, J.C.S. (Philips Res. Lab., Eindhoven, Netherlands)
SO   Journal of Applied Physics (1 April 1995) vol.77, no.7, p.2993-8. 18 refs.
     Price: CCCC 0021-8979/95/77(7)/2993/6/$6.00
     CODEN: JAPIAU ISSN: 0021-8979
AB   The effect of energetic particle bombardment during sputter deposition on the
     physical (magnetoresistance and interlayer coupling) and microstructural
     (roughness and interface thickness) properties of exchange-biased **spin-valve**
     multilayers is investigated. An increasing pressure leads, through enhanced
     stopping of energetic particles by collisions with the background gas, to a
     decrease of the interfacial intermixing by collisions during growth, and to a
     more rough, void-rich structure. These microstructural changes lead to an
     increase of the transmissivity of the interfaces for conduction electrons, as
     well as to an increase of the **ferromagnetic** interlayer **coupling** with increasing
     pressure.
CT   CHEMICAL INTERDIFFUSION; ENERGY LOSS OF PARTICLES; EXCHANGE INTERACTIONS
     (ELECTRON); FERROMAGNETISM; GIANT MAGNETORESISTANCE; INTERFACE STRUCTURE;
     ION BEAM MIXING; MAGNETIC MULTILAYERS; METALLIC SUPERLATTICES; PERMALLOY;
     SPUTTER DEPOSITION; SURFACE DIFFUSION; **SURFACE
     TOPOGRAPHY**; VOIDS (SOLID)
ST   sputter deposition; energetic particle bombardment; **exchange-biased
     spin-valve multilayers**; magnetoresistance; roughness; interface
     thickness; interfacial intermixing; void-rich structure; transmissivity;
     ferromagnetic interlayer coupling; Ni80Fe20; GMR effect

L11 ANSWER 27 OF 28 INSPEC (C) 2004 IEE on STN
AN   1996:5205731 INSPEC   DN A9607-7570-041; B9604-3110M-008 <u>Full-text</u>
TI   STM studies of GMR **spin valves**.
AU   Misra, R.D.K.; Ha, T.; Kadmon, Y.; Powell, C.J.; Stiles, M.D.; McMichael,
     R.D.; Egelhoff, W.F., Jr. (Nat. Inst. of Stand. & Technol., Gaithersburg,
     MD, USA)
SO   Magnetic Ultrathin Films, Multilayers and Surfaces. Symposium
     Editor(s): Marinero, E.E.; Heinrich, B.; Egelhoff, W.F., Jr.; Fert, A.;
     Fujimori, H.; Guntherodt, G.; White, R.L.
     Pittsburgh, PA, USA: Mater. Res. Soc, 1995. p.373-83 of xii+553 pp.

AB   We have investigated the surface roughness and the grain size in giant
     magnetoresistance (GMR)**spin valve** multilayers of the general type:
     FeMn/Ni80Fe20/Co/Cu/Co/Ni80Fe20 on glass and aluminium oxide substrates by
     scanning tunneling microscopy (STM). The two substrates give very similar
     results. These polycrystalline GMR multilayers have a tendency to exhibit larger
     grain size and increased roughness with increasing thickness of the metal layers.
     Samples deposited at a low substrate temperature (150 K) exhibit smaller grains
     and less roughness. Valleys between the dome-shaped individual grains are the
     dominant form of roughness. This roughness contributes to the **ferromagnetic,**
     magnetostatic **coupling** in these films, an effect termed 'orange peel' coupling by
     Neel. We have calculated the strength of this coupling, based on our STM images,
     and obtain values generally within about 20% of the experimental values. It
     appears likely that the **ferromagnetic coupling** generally attributed to so-called
     'pinholes' in the Cu when the Cu film thickness is too small is actually 'orange
     peel' coupling caused by these valleys.
CT   COBALT; COPPER; FERROMAGNETIC MATERIALS; GIANT MAGNETORESISTANCE; GRAIN
     SIZE; IRON ALLOYS; MAGNETIC MULTILAYERS; MAGNETIC PARTICLES; MAGNETOSTATIC
     WAVES; MANGANESE ALLOYS; METALLIC SUPERLATTICES; NICKEL ALLOYS; SCANNING
     TUNNELLING MICROSCOPY; **SURFACE TOPOGRAPHY**
ST   orange peel coupling; surface roughness; grain size; giant
     magnetoresistance; **spin valve multilayers**; scanning tunneling
     microscopy; substrate temperature; magnetostatic coupling;
     ferromagnetic coupling; film thickness; 150 K;
     FeMn-Ni80Fe20-Co-Cu-Co-Ni80Fe20

L19 ANSWER 5 OF 38 HCAPLUS COPYRIGHT 2004 ACS on STN
AN   2001:589460 HCAPLUS Full-text
DN   135:297356
TI   Structural and magnetoresistive properties of Co/Cu multilayers
AU   Marszalek, M.; Jaworski, J.; Michalik, A.; Prokop, J.; Stachura, Z.;
     Voznyi, V.; Bolling, O.; Sulkio-Cleff, B.
CS   H. Niewodniczanski Institute of Nuclear Physics, Krakow, 31-342, Pol.
SO   Journal of Magnetism and Magnetic Materials (2001), 226-230(Pt. 2),
     1735-1737
     CODEN: JMMMDC; ISSN: 0304-8853
PB   Elsevier Science B.V.
AB   Co/Cu multilayers (ML) were thermally evaporated at very low deposition rates on
     Si substrates covered with buffer layers of different metals (Ag, Cu, In, Pb,
     Bi). Structural characterization of samples was performed by x-ray reflectometry
     (XRR), XRD and atomic force microscopy (AFM). Magnetoresistance measurements were
     carried out at room temperature using a standard 4-probe d.c. method with current
     in the plane of the sample. It seems that a choice of buffer type has no
     significant effect on the magnitude of **GMR**. Since the thickness of single layers
     is of similar magnitude as the interfacial **roughness** in samples the authors
     suggest that the observed small value of **GMR** effect can be attributed rather to
     the interruption of film continuity and creation of magnetic bridges between Co
     layers, resulting in direct **ferromagnetic coupling** of magnetic films.
CC   77-1 (Magnetic Phenomena)
IT   Evaporation
     Ferromagnetic exchange
     Giant magnetoresistance
     Grain size
     Interface **roughness**
     Magnetic films
     Magnetic multilayers
     Magnetoresistance
     Order
        (structural and magnetoresistive properties of Co/Cu multilayers)

L19 ANSWER 6 OF 38   HCAPLUS   COPYRIGHT 2004 ACS on STN
AN   2001:502087 HCAPLUS DN   135:265908
TI   Magnetoresistance and magnetic properties of magnetic thin film multilayers
AU   Neamtu, J.; Volmer, M.
SO   Surface Science (2001), 482-485(Pt. 2), 1010-1014
     CODEN: SUSCAS; ISSN: 0039-6028

AB   The magnetic properties and the magnetoresistance in correlation with
     microstructural properties of permalloy monolayer and [NiFe(t)/Cu(s)/NiFe(t)]n or
     [NiFe(t)/Mo(s)/NiFe(t)] multilayers have been studied. The thickness (t) of NiFe
     layers was ranged from 4-12 nm, while the Cu and Mo layers (s) were ranged from
     3-8 nm. The multilayers exhibit magnetoresistive properties different from those
     of permalloy film. By decreasing of the NiFe layer thickness and increasing of
     the nonmagnetic interlayer thickness, the influence of interfacial intermixing
     effects on magnetic properties become more important. The magnetic properties of
     [NiFe/Mo/NiFe] trilayer show a weak **ferromagnetic coupling** like those presented
     by the multilayers with a relatively thick nonmagnetic interlayer (5-8 nm).
     Although the thickness of layers has the leading part for magnitude of **GMR**
     effect, the microstructural properties of interfaces and the grain boundaries
     scattering must not be neglected.
IT   Giant magnetoresistance
     Surface **roughness**
         (magnetoresistance and magnetic properties of magnetic thin film
         multilayers)

L19   ANSWER 18 OF 38 HCAPLUS COPYRIGHT 2004 ACS on STN
AN   1997:779027 HCAPLUS DN   128:109012
TI   Oxygen as a surfactant in the growth of giant magnetoresistance spin valves
AU   Egelhoff, W. F., Jr.; Chen, P. J.; Powell, C. J.; Stiles, M. D.;
      McMichael, R. D.; Judy, J. H.; Takano, K.; Berkowitz, A. E.
SO   Journal of Applied Physics (1997), 82(12), 6142-6151
      CODEN: JAPIAU; ISSN: 0021-8979
PB   American Institute of Physics
AB   The authors found a novel method for increasing the giant magnetoresistance (**GMR**)
      of Co/Cu spin valves using O. Surprisingly, spin valves with the largest **GMR** are
      not produced in the best vacuum. Introducing 5+10-9 Torr (7+10-7 Pa) into the
      authors' ultrahigh vacuum deposition chamber during spin-valve growth increases
      the **GMR**, decreases the **ferromagnetic coupling** between magnetic layers, and
      decreases the sheet resistance of the spin valves. Apparently the O may act as a
      surfactant during film growth to suppress defects and to create a surface which
      scatters electrons more specularly. Using this technique, bottom spin valves and
      sym. spin valves with **GMR** values of 19.0 and 24.8, resp., were produced. These
      are the largest values ever reported for such structures.
IT   Crystal defects
      Ferromagnetic exchange
      Giant magnetoresistance
      Interface **roughness**
      Sheet resistance
      Sputtering
      Surfactants
         (oxygen as surfactant in growth of cobalt/copper spin valves with giant
         magnetoresistance)

L19 ANSWER 21 OF 38 HCAPLUS COPYRIGHT 2004 ACS on STN
AN   1996:592293 HCAPLUS DN   125:236548
TI   Quenching of giant magnetoresistance by interface **roughening** and
     alloying in annealed [(NixFe1-x)yAu1-y]/Au multilayers
AU   Farrow, R. F. C.; Parkin, S. S. P.; Marks, R. F.; Krishnan, Kannan M.;
     Thangaraj, N.
SO   Applied Physics Letters (1996), 69(13), 1963-1965
     CODEN: APPLAB; ISSN: 0003-6951
AB   Antiferromagnetically coupled permalloy/Au multilayers display giant
     magnetoresistance (**GMR**) with large changes in resistance in very low fields.
     Thermal annealing of such structures, exhibiting **GMR** , leads to a quenching of
     the magnetoresistance. The detailed structure of the permalloy/Au interfaces was
     probed using high-resolution cross-section TEM. On annealing, the Au layers
     interdiffuse into the permalloy layers, which leads both to **rougher** permalloy/Au
     interfaces and to thinner Au spacer layers. The authors infer that the latter
     results in **ferromagnetic coupling** of the permalloy layers, which accounts for the
     reduced **GMR.**

L19 ANSWER 23 OF 38 HCAPLUS COPYRIGHT 2004 ACS on STN
AN   1996:282201 HCAPLUS DN   125:24577
TI   In situ scanning tunneling microscopy observation of surface evolution in
     magnetically coupled Co/Cu multilayers
AU   Minvielle, Timothy J.; Wilson, Robert J.; White, Robert L.
SO   Applied Physics Letters (1996), 68(19), 2750-2752
     CODEN: APPLAB; ISSN: 0003-6951
AB   Bilayers Cu(100)/[Co(21 Å)/Cu(21 Å)]n were grown by both ion beam and d.c.
     magnetron sputtering techniques. Scanning tunneling microscopy images of the
     developing layers demonstrate a marked difference in the way in which **roughness**
     evolves through the films. The higher energy ion beam sputtered systems show a
     nonconformal **roughness** that was characterized by comparatively large lateral
     length scales. The less energetic magnetron-formed systems exhibit an island-
     upon-island growth that is conformal from layer to layer. Kerr effect
     measurements show that the former is **ferromagnetically coupled** and the latter is
     antiferromagnetically coupled. An explanation is presented that attributes the
     differences in **roughness** to the potential barriers at step edges. Adatom
     mobility and incident energy are the determining factor for this kind of
     conformal growth.

L19   ANSWER 26 OF 38   HCAPLUS   COPYRIGHT 2004 ACS on STN
AN   1995:946644   HCAPLUS DN   124:18949
TI   STM studies of **GMR** spin valves
AU   Misra, R. D. K.; Ha, T.; Kadmon, Y.; Powell, C. J.; Stiles, M. D.;
      McMichael, R. D.; Egelhoff, W. F., Jr.
SO   Materials Research Society Symposium Proceedings (1995), 384(Magnetic
      Ultrathin Films Multilayers and Surfaces), 373-83
      CODEN: MRSPDH; ISSN: 0272-9172

AB   The authors have studied the surface **roughness** and the grain size in giant
      magnetoresistance (**GMR**) spin valve multilayers of the general type:
      FeMn/Ni80Fe20/Co/Cu/Co/Ni80Fe20 on glass and Al oxide substrates by scanning
      tunneling microscopy (STM). The 2 substrates give very similar results. These
      polycryst. **GMR** multilayers have a tendency to exhibit larger grain size and
      increased **roughness** with increasing thickness of the metal layers. Samples
      deposited at a low substrate temperature (150 K) exhibit smaller grains and less
      roughness . Valleys between the dome-shaped individual grains are the dominant
      form of **roughness**. This **roughness** contributes to the **ferromagnetic,**
      magnetostatic **coupling** in these films, an effect termed orange peel coupling by
      Neel. The authors have calculated the strength of this coupling, based on the
      STM images, and obtain values generally within .apprx.20% of the exptl. values.
      It appears likely that the **ferromagnetic coupling** generally attributed to so-
      called pinholes in the Cu when the Cu film thickness is too small is actually
      orange peel coupling caused by these valleys.
IT   Surface structure
         (**roughness,** STM studies of giant magnetoresistance
         FeMn/Ni80Fe20/Co/Cu/Co/Ni80Fe20 spin valves on glass and Al oxide
         substrates)

L19 ANSWER 34 OF 38 INSPEC (C) 2004 IEE on STN
AN   2001:6961257 INSPEC   DN A2001-15-7570C-032; B2001-08-3110M-018
TI   Reduction of interlayer coupling in bottom synthetic spin valves through a
     gas exposure process.
AU   Makino, E.; Ishii, S.; Syoji, M.; Furukawa, A.; Hosomi, M.; Matuzono, A.
SO   Journal of Applied Physics (1 June 2001) vol.89, no.11, pt.1-2, p.7619-21.8 refs.
     Doc. No.: S0021-8979(01)26611-0
     CODEN: JAPIAU ISSN: 0021-8979
     Conference: Eighth Joint Magnetism and Magnetic Materials Intermag
     Conference. San Antonio, TX, USA, 7-11 Jan 2001
AB   The magnetoresistance (MR) ratio of spin valves can be improved by reducing the
     thickness of the nonmagnetic interlayer, such as Cu, due to not only reducing the
     shunt, but also increasing the probability of electrons scattered through the Cu.
     However, at small thickness, interlayer coupling between the free and pinned
     layer is increased, which makes it difficult to control the bias point. The
     minimum thickness of the interlayer Cu was thereby limited to around 3 nm. On the
     other hand, it is reported that the **ferromagnetic** interlayer **coupling** that arises
     from the film **roughness** can be reduced by controlling the residual gas inside the
     deposition chamber. The same effect can also be achieved by exposing the wafer
     into an oxygen gas atmosphere right after the deposition of the high conductive
     Cu interlayer. By this method the thickness of the interlayer Cu was reduced
     successfully from 3.0 to 2.0 nm without increasing the interlayer coupling. As a
     result, the MR ratio and dRsq was improved by 12% and 48%, and showed 10% and
     1.82 Omega , respectively. Furthermore, by inserting a Cu backlayer to form a
     spin filter spin valve structure an antiferromagnetic interlayer coupling was
     also observed.
ST   interlayer coupling reduction; bottom synthetic spin valves; gas exposure
     process; magnetoresistance ratio; nonmagnetic interlayer thickness
     reduction; bias point; minimum thickness; ferromagnetic interlayer;
     antiferromagnetic interlayer; giant magnetoresistance; **GMR**; Cu

L23 ANSWER 3 OF 17   HCAPLUS   COPYRIGHT 2004 ACS on STN
AN   2001:245377 HCAPLUS DN   135:13402
TI   Studies on interfacial and crystalline structures of **spin-
     valve** multilayers
AU   Lu, Zhengqi; Wang, Wendong; Chai, Chunlin; Lai, Wuyan; Zheng, Yuankai
SO   IEEE Transactions on Magnetics (2000), 36(5, Pt. 1), 2869-2871
     CODEN: IEMGAQ; ISSN: 0018-9464
AB   **Spin valves** of high quality were fabricated by a two-step deposition procedure.
     Lower sublayers (i.e., buffer layer Ta/free layer NiFe/interlayer Cu) are
     deposited at a lower argon pressure, which promotes the formation of strong (111)
     textures, **smooth** interfaces, and dense Cu film, and upper sublayers (i.e., pinned
     layer NiFe/pinning layer FeMn/cover Ta) are deposited at a higher pressure, which
     promotes small grains and less diffusive interface. The independent control of
     the magnetoresistance, the **ferromagnetic** interlayer **coupling,** and exchange
     biasing is achieved by improving the interfacial and crystalline structures of
     the **spin valves.**

L23   ANSWER 4 OF 17   HCAPLUS   COPYRIGHT 2004 ACS on STN
AN   2000:561582 HCAPLUS DN   133:259789
TI   Magnetoresistance enhancement in specular, bottom-pinned, Mn83Ir17
      spin valves with nano-oxide layers
AU   Veloso, A.; Freitas, P. P.; Wei, P.; Barradas, N. P.; Soares, J. C.;
      Almeida, B.; Sousa, J. B.
SO   Applied Physics Letters (2000), 77(7), 1020-1022
      CODEN: APPLAB; ISSN: 0003-6951

AB   Bottom-pinned Mn83Ir17 **spin valves** with enhanced specular scattering were
fabricated, showing magnetoresistance (MR) values up to 13.6%, lower sheet resistance
R.box. and higher ΔR.box.. Two nano-oxide layers (NOL) are grown on both sides of the
CoFe/Cu/CoFe **spin valve** structure by natural oxidation or remote plasma oxidation of
the starting CoFe layer. Maximum MR enhancement is obtained after just 1 min plasma
oxidation RBS anal. shows that a 15 ± 2 Å oxide layer grows at the expense of the
initial (prior to oxidation) CoFe layer, with .apprx.12% reduction of the initial 40-Å
CoFe thickness. X-ray reflectometry indicates that Kiessig fringes become better
defined after NOL growth, indicating **smoother** inner interfaces, in agreement with the
observed decrease of the **spin-valve ferromagnetic** Neel **coupling.**

L23   ANSWER 14 OF 17   INSPEC   (C) 2004 IEE on STN
AN   1999:6235660 INSPEC   DN A1999-11-7570C-008; B1999-06-3110M-003
TI   Effect of finite magnetic film thickness on Neel coupling in **spin valves**.
AU   Kools, J.C.S.; Kula, W. (CVC, Fremont, CA, USA); Mauri, D.; Lin, T.
SO   Journal of Applied Physics (15 April 1999) vol.85, no.8, p.4466-8. 16 Refs.
      Doc. No.: S0021-8979(99)18808-X
      CODEN: JAPIAU ISSN: 0021-8979
      Conference: 43rd Annual Conference on Magnetism and Magnetic Materials.
      Miami, FL, USA, 9-12 Nov 1998

AB   **Spin valves** are widely studied due to their application as magnetoresistive
      material in magnetic recording heads and other magnetic field sensors. An
      important film property is the interlayer coupling field (called offset field Ho
      or **ferromagnetic coupling** field Hf). It has been shown that the Neel model for
      orange-peel coupling can be applied successfully to describe this interlayer
      coupling. The **waviness** associated with the developing granular structure is
      thereby taken as the relevant **waviness**. The original Neel model describes the
      ferromagnetic magnetostatic interaction between two ferromagnetic layers, of
      infinite thickness, separated by a nonmagnetic spacer with a correlated interface
      waviness. In this article, this physical picture is refined to account for the
      effect of the finite thickness of the magnetic films in a **spin valve**. Magnetic
      poles created at the outer surfaces of the magnetic layers result in an
      antiferromagnetic interaction with the poles at the inner surface of the opposite
      layer. A simple model is presented for the different interactions in a top **spin
      valve** (columnar structure with cumulative **waviness** on a flat substrate) and for a
      bottom **spin valve** (columnar structure with conformal **waviness** on a way
      substrate). Comparison to experimental data, shows that the free and pinned layer
      thickness dependence can be understood from this refined picture.
ST   **correlated interface waviness**; magnetic films; magnetic poles;

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L15  ANSWER 2 OF 5  HCAPLUS  COPYRIGHT 2004 ACS on STN
AN   1998:696816  HCAPLUS DN   130:9547
TI   Manufacture of magnetoresistance-effect multilayer films
IN   Noguchi, Noboru
PA   Hitachi Metals, Ltd., Japan
IC   ICM  G11B005-39
     ICS  H01F041-18; H01L043-12
     PATENT NO.       KIND  DATE        APPLICATION NO.  DATE
PI   JP 10289421      A2    19981027    JP 1997-98609    19970416
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AB   The title manufacture of spin valve films with Mn-Ni alloy antiferromagnetic
materials by **ferromagnetic**/antiferromagnetic exchange- **coupled** magnetic field involves
forming a Mn-Ni alloy antiferromagnetic layer on a substrate, depositing a
ferromagnetic layer, annealing the laminate film under a magnetic field in a desired
orientation to provide a exchange-coupled magnetic field, ·ion- **milling** to remove a
portion of the ferromagnetic layer not to expose the antiferromagnetic layer, forming
a pinning layer, depositing a non-magnetic layer, and subsequently forming an exchange
field-free ferromagnetic layer. The manufacturing process provides the corrosion-
resistant and thermal-resistant spin valve films without characteristic deterioration
during annealing in the magnetic field. The products provides high-quality MR heads
with decreased noise and hysteresis.

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L22   ANSWER 25 OF 30   HCAPLUS   COPYRIGHT 2004 ACS on STN
AN    1983:45704   HCAPLUS
TI    Sloping insulative layer in bubble memory
IN    Silverman, Peter J.
PA    Intel Magnetics, Inc., USA
      PATENT NO.        KIND   DATE          APPLICATION NO.   DATE
PI    US 4358356        A      19821109      US 1981-252798    19810413 <--
PRAI  US 1981-252798           19810413  <--
AB    A method for removing rounded regions in SiO2 layers covering Permalloy
      conductors consists of ion milling the layer at an angle of incidence of 0° with
      respect to the planar surface and 45° with respect to the rounded region.
IC    C23F001-02
NCL   204192000E
IT    Memory devices
         (magnetic, bubble-domain, ion beam milling
         of silica rounded layers in)
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L11 ANSWER 7 OF 30 INSPEC   (C) 2004 IEE on STN
AN   2002:7394118 INSPEC   DN   A2002-21-6820-035; B2002-11-2550E-025 <u>Full-text</u>
TI   ░Smoothing thin films░ with gas-cluster ion beams.
AU   Fenner, D.B.; Hautala, J.; Allen, L.P.; Greer, J.A.; Skinner, W.J.); Budnick,J.I.
SO   Magnetic Materials, Structures and Processing for Information Storage.
     Symposium (Materials Research Society Symposium Proceedings Vol.614)
     Editor(s): Daniels, B.J.; Nolan, T.P.; Seigler, M.A.; Wang, S.X.; Murray, C.B.
     Warrendale, PA, USA: Mater. Res. Soc, 2001. p.F10.3.1-6 of xi+178 pp. 18 refs.
     Conference: San Francisco, CA, USA, 24-27 April 2000
     ISBN: 1-55899-522-6

AB   Thin-film magnetic sensor and memory devices in future generations may benefit
     from a processing tool for final-step etching and smoothing of surfaces to nearly
     an atomic scale. Gas-cluster ion-beam (GCIB) systems make possible improved
     surface sputtering and processing for many types of materials. We propose
     application of GCIB processing as a key smoothing step in thin-film magnetic-
     materials technology, especially spin-valve GMR. Results of argon GCIB etching
     and smoothing of surfaces of alumina, silicon, permalloy and tantalum films are
     reported. No accumulating roughness or damage is observed. The distinct scratches
     and tracks seen in atomic-force microscopy of CMP-processed surfaces, are removed
     almost entirely by subsequent GCIB processing. The technique primarily reduces
     high spatial-frequency roughness and renders the topographic surface elevations
     more nearly gaussian (randomly distributed).
CT   ALUMINA; ARGON; ATOMIC FORCE MICROSCOPY; ELEMENTAL SEMICONDUCTORS; GIANT
     MAGNETORESISTANCE; ION BEAMS; MAGNETIC THIN FILMS; PERMALLOY; ROUGH
     SURFACES; SILICON; SPIN VALVES; **SPUTTER ETCHING;**
     SURFACE TOPOGRAPHY; TANTALUM
ST   A12O3 thin film; Si thin film; permalloy thin film; tantalum thin film;
     thin film smoothing; gas cluster ion beams; GCIB; magnetic sensor;
     magnetic memory device; etching; magnetic materials; **spin valve**
     GMR; argon; atomic force microscopy; CMP; surface roughness; surface
     topographic elevations; Gaussian distribution; Al2O3; Ta; Si; NiFe; Ar

L11   ANSWER 9 OF 30   INSPEC   (C) 2004 IEE on STN
AN   2002:7291390   INSPEC   DN   A2002-14-7570P-032; B2002-07-3110M-016 <u>Full-text</u>
TI   Fabrication and magnetoresistance properties of **spin-**
      dependent tunnel junctions using an epitaxial Fe3O4 film. $FY/$
AU   Matsuda, H.; Takeuchi, M.; Adach, H.; Hiramoto, M.; Matsukawa, N.; Odagawa,
      A.; Setsune, K.; Sakakima, H.
SO   Japanese Journal of Applied Physics, Part 2 (Letters) (1 April 2002)
      vol.41, no.4A, p.L387-90. 16 refs.
      Published by: Japan Soc. Appl. Phys
      CODEN: JAPLD8   ISSN: 0021-4922
AB   Magnetoresistance of **spin-dependent tunnel** junctions has been studied using a
      high-quality epitaxial Fe3O4 film. The bottom magnetic electrodes of epitaxial
      Fe3O4 were grown onto the TiN-buffered (110) surface of MgO single-crystal
      substrates, and trilayer junctions of Fe3O4/AlOx/CoFe **mesa** were fabricated by
      sequential sputtering and Ar **ion etching**. The junctions showed the
      magnetoresistance (MR) ratio of more than 10% at room temperature with butterfly-
      like hysteresis which arose from the different coercive fields between Fe3O4 and
      CoFe when the field was applied along the easy axis of the epitaxial Fe3O4 layer.
      The MR ratio remained almost constant against the temperature down to nearly 100
      K. Below 100 K, the decrease of MR and the increase of junction resistance were
      observed, which may be related to the Verwey transition that inevitably occurs in
      the characteristic of high-quality Fe3O4 samples.
ST   magnetoresistance; **spin-dependent tunnel junctions**; MR ratio;
      epitaxial Fe3O4 film; TiN-buffered MgO(110) surface; trilayer junctions;
      Fe3O4/AlOx/CoFe mesa; sequential sputtering; **Ar ion**
      etching; coercive fields; temperature effects; junction resistance;
      Verwey transition; 300 K; 100 K; Fe3O4-TiN-MgO; MgO; Fe3O4-AlO-CoFe; Ar

L11   ANSWER 11 OF 30   INSPEC   (C) 2004 IEE on STN
AN   2002:7148674 INSPEC   DN A2002-04-6865-021 <u>Full-text</u>
TI   Microstructure of Co/Cu multilayers studied by low-angle X-ray diffraction
      and scanning force microscopy.
AU   Marszalek, M.; Jaworski, J. im. H. Niewodniczanskiego, Krakow, Poland);
      Marszalek, K.; Bolling, O.;
      Sulkio-Cleff, B.
SO   Elektronika (2001) vol.42, no.8-9, p.81-3. 5 refs. Published by: SIGMA NOT
      CODEN: EKNTBZ ISSN: 0033-2089
AB   In this paper we present the studies of the microstructure of Co/Cu multilayers
      (ML) at the second antiferromagnetic maximum of exchange coupling and the
      influence of microstructure on the giant magnetoresistivity. Co/Cu multilayers
      were thermally evaporated on Si substrates covered with buffer layers of
      different metals known as surfactants (Ag, Cu, In, Pb, Bi). Surfactant properties
      lead in epitaxial growth to the layer-by-layer growth in conditions when usually
      3D growth is observed. Structural characterisation of samples performed by low-
      angle X-ray diffraction resulted in determining of the structure and the
      interface roughness of the studied systems. The **topography** of the **surface** of ML
      and of the buffer layers has been measured with scanning force microscopy (SFM).
      Magnetoresistance measurements were carried out at room temperature using a
      standard four-probe DC method with current in the plane of the sample. It seems
      that a choice of buffer type have no significant effect on the magnitude of **GMR**.
      The influence of the roughness on the giant magnetoresistivity is negligible.
      However, the correlation between **GMR** and the size of islands on the sample
      surface has need observed. We suggest that the observed effect can be attributed
      to the interruption of film continuity and the formation of magnetic bridges
      between Co layers, resulting in direct **ferromagnetic coupling** of magnetic films.
      The creation of granular entities due to the enhanced interlayer diffusion caused
      by the presence of surfactant metals is the most likely source of **GMR** in studied
      samples.
ST   microstructure; multilayers; low-angle X-ray diffraction; scanning force
      microscopy; SFM; second antiferromagnetic maximum; exchange coupling;
      giant magnetoresistivity; epitaxial growth; layer-by-layer growth; room
      temperature; **GMR**; enhanced interlayer diffusion; 293 K; Si; Co-Cu

L11 ANSWER 19 OF 30 INSPEC (C) 2004 FIZ KARLSRUHE on STN
AN   1999:6334993 INSPEC   DN A1999-19-7570C-048; B1999-10-3110M-004 <u>Full-text</u>
TI   Properties of spin-valve structures deposited on step-bunched vicinal surfaces.
AU   Encinas, A.; Nguyen Van Dau, F.; Schuhl, A.; Montaigne, F.; Sussiau, M.;
     Galtier, P. (Thomson-CSF, Orsay, France)
SO   Journal of Magnetism and Magnetic Materials (June 1999) vol.198-199, p.15-17.
Doc. No.: S0304-8853(98)00595-2
     CODEN: JMMMDC ISSN: 0304-8853
     Conference: Third International Symposium on Metallic Multilayers
     (MML'98). Vancouver, BC, Canada, 14-19 June 1998

AB   We have investigated the properties of Co/Cu/FeNi spin-valve structures deposited
     on step-bunched vicinal Si(111) substrates. We first discuss the in-plane
     uniaxial magnetic anisotropy induced in each magnetic layer by the initial
     surface corrugation. A **ferromagnetic coupling** of the two magnetizations is found,
     which is analyzed as a function of the spacer-layer thickness. Giant
     magnetoresistance (**GMR**) of the spin-valve structures is then investigated as a
     function of the in-plane current direction. Because of the initial corrugation,
     we observe current perpendicular to the plane (CPP) contributions to the **GMR** of
     the spin-valve structures. These CPP contributions can lead to an increase of the
     absolute **GMR** by up to 70% at room temperature, when the current is applied
     perpendicular to the steps direction.
CT   COBALT; GIANT MAGNETORESISTANCE; INDUCED ANISOTROPY (MAGNETIC); IRON
     ALLOYS; MAGNETIC MULTILAYERS; NICKEL; NICKEL ALLOYS; SPIN VALVES;
     SURFACE TOPOGRAPHY
ST   spin-valve structures; step-bunched vicinal surfaces; Si(111) substrate;
     uniaxial magnetic anisotropy; magnetic multilayer; surface corrugation;
     ferromagnetic coupling; magnetization; spacer-layer thickness
     dependence; giant magnetoresistance; plane-perpendicular current;
     interlayer coupling; 30 to 200 angstrom; Co-Cu-FeNi; Si

L11 ANSWER 25 OF 30   INSPEC   (C) 2004 IEE on STN
AN   1997:5712419 INSPEC   DN A9722-7570-016; B9711-3110M-030 <u>Full-text</u>
TI   In situ and ex situ observation of spin valves obtained by ion-beam
     deposition.
AU   Guarisco, D.; Kay, E.; Wang, S.X.
SO   IEEE Transactions on Magnetics (Sept. 1997) vol.33, no.5, pt.2, p.3595-7.
     11 refs. Published by: IEEE
     CODEN: IEMGAQ ISSN: 0018-9464
     Conference: 1997 IEEE International Magnetics Conference (INTERMAG '97).
     New Orleans, LA, USA, 1-4 April 1997

AB   "Bottom" spin valves of the type NiO/15 AA NiFe/15 AA Co/tCu Cu/20 AA Co/50 AA
     NiFe were prepared by ion-beam deposition (IBD) on a Si(100)/NiO substrate. It is
     found that cleaning the substrates by **ion**-beam **etching** prior to the deposition of
     the multilayer has a significant influence on the magnetic properties of the spin
     valve. In particular, longer etching leads to a decrease in the exchange field
     and an increase in the coercivity of the pinned layer, without affecting the **GMR**
     ratio. A maximum **GMR** of 11.2% at room temperature is obtained for tCu=20 AA and
     240 s etching time. The NiO substrate before and after **ion**-beam **etching** has been
     studied by atomic force microscopy (AFM). No significant change in roughness is
     observed, but the etched substrate shows smaller features.

CT   ANTIFERROMAGNETIC MATERIALS; ATOMIC FORCE MICROSCOPY; COBALT; COERCIVE
     FORCE; COPPER; EXCHANGE INTERACTIONS (ELECTRON); FERROMAGNETIC MATERIALS;
     GIANT MAGNETORESISTANCE; INTERFACE STRUCTURE; IRON ALLOYS; MAGNETIC
     MULTILAYERS; NICKEL ALLOYS; NICKEL COMPOUNDS; SOFT MAGNETIC MATERIALS;
     SPUTTER DEPOSITION; **SPUTTER ETCHING**; SURFACE CLEANING;
     SURFACE TOPOGRAPHY

ST   in situ observation; ex situ observation; spin valves; ion-beam
     deposition; NiO/NiFe/Co/Cu/Co/NiFe; bottom spin valves; Si(100)/NiO
     substrate; cleaning; **ion-beam etching**; magnetic properties;
     exchange field; coercivity; pinned layer; **GMR ratio**; room
     temperature; etching time; NiO substrate; atomic force microscopy; AFM;
     roughness; etched substrate; 15 A; 20 A; 50 A; 20 C; 240 s;
     NiO-NiFe-Co-Cu-Co-NiFe

L11   ANSWER 26 OF 30   INSPEC   (C) 2004 IEE on STN
AN   1996:5408751 INSPEC   DN A9623-7570-032; B9612-3110M-009 <u>Full-text</u>
TI   Interlayer coupling and surface roughness in **GMR** spin valves.
AU   Wei, D.; Bertram, H.N. (Center for Magnetic Recording Res., California
      Univ., San Diego, La Jolla, CA, USA)
SO   IEEE Transactions on Magnetics (Sept. 1996) vol.32, no.5, pt.1, p.3434-6.8 refs.
      Published by: IEEE
      CODEN: IEMGAQ ISSN: 0018-9464
      Conference: 1996 IEEE International Magnetics Conference (INTERMAG '96).
AB   An atomic-scale model is developed to analyze interlayer coupling in
      permalloy/silver/permalloy **GMR** spin valves. The coupling in a smooth interface
      spin valve is assumed to be anti-ferromagnetic due to interlayer electron
      scattering. With rough silver/permalloy interfaces, the **coupling** remains anti-
      ferromagnetic even with the enhanced magnetostatic energy.
CT   GIANT MAGNETORESISTANCE; MAGNETIC MULTILAYERS; PERMALLOY; SILVER;
      SURFACE TOPOGRAPHY
ST   interlayer coupling; surface roughness; atomic-scale model;
      permalloy/silver/permalloy GMR spin valve; antiferromagnetic
      coupling; electron scattering; magnetostatic energy; NiFe-Ag-NiFe

L11 ANSWER 12 OF 30 INSPEC   (C) 2004 IEE on STN
AN   2001:6961335 INSPEC   DN B2001-08-3120B-006 <u>Full-text</u>
TI   **Magnetic tunnel** junctions on **magnetic** shield
     smoothed by gas cluster ion beam.
AU   Sun, J.J.; Shimazawa, K.; Kasahara, N.; Sato, K.; Kagami, T.; Saruki, S.;
     Araki, S.; Matsuzaki, M.
SO   Journal of Applied Physics (1 June 2001) vol.89, no.11, pt.1-2, p.6653-5.11 refs.
     Doc. No.: S0021-8979(01)38011-8
     Published by: AIP
     CODEN: JAPIAU ISSN: 0021-8979
     Conference: Eighth Joint Magnetism and Magnetic Materials Intermag
     Conference. San Antonio, TX, USA, 7-11 Jan 2001

AB   In this work, a technique, gas cluster ion beam (GCIB), was introduced to smooth
        the bottom NiFe magnetic shield for **magnetic tunnel** junction (MTJ) read heads.
        The GCIB treatment can bring the surface roughness of the shield from 15 to 20 AA
        to around 5 AA, and the most of scratch marks can be removed. The efficiency of
        the GCIB process is dependent on the initial surface morphology. The MTJs grown
        on the magnetic shield smoothed by the GCIB show that the resistance area product
        RA is increased from 60 to 100 Omega mu m2 with the GCIB dose up to $1*10^{16}$
        ions/cm2, arising from a smooth insulating layer, meanwhile, the **tunneling
        magnetoresistance (TMR)** is almost constant or slightly decreases. This GCIB
        process can also improve breakdown voltage (approximately 0.019 V per 10^{15}
        ions/cm2) of the MTJs, and slightly increase the **ferromagnetic coupling** mainly
        due to the change of the surface morphology. Using this technology, an RA as low
        as 3.5-6.5 Omega mu m2 together with a **TMR** of 14%-18% can be obtained for MTJs
        grown on the GCIB treated NiFe magnetic shield.
CT   FERROMAGNETIC MATERIALS; ION BEAM APPLICATIONS; IRON ALLOYS; MAGNETIC
     HEADS; MAGNETIC MULTILAYERS; MAGNETIC SHIELDING; MAGNETORESISTIVE DEVICES;
     NICKEL ALLOYS; ROUGH SURFACES; **SURFACE TOPOGRAPHY;**
     TUNNELLING
ST   **magnetic tunnel junctions;** magnetic shield; gas cluster ion
     beam; NiFe magnetic shield; read heads; surface roughness; surface
     morphology; resistance area product; insulating layer; **tunneling
     magnetoresistance;** breakdown voltage; **ferromagnetic coupling;** NiFe

L11 ANSWER 27 OF 30 INSPEC (C) 2004 IEE on STN
AN 1996:5205731 INSPEC DN A9607-7570-041; B9604-3110M-008 <u>Full-text</u>
TI STM studies of **GMR** spin valves.
AU Misra, R.D.K.; Ha, T.; Kadmon, Y.; Powell, C.J.; Stiles, M.D.; McMichael,
 R.D.; Egelhoff, W.F., Jr.
SO Magnetic Ultrathin Films, Multilayers and Surfaces. Symposium
 Editor(s): Marinero, E.E.; Heinrich, B.; Egelhoff, W.F., Jr.; Fert, A.;
 Pittsburgh, PA, USA: Mater. Res. Soc, 1995. p.373-83 of xii+553 pp. 9 refs.
AB We have investigated the surface roughness and the grain size in giant
 magnetoresistance (**GMR**) spin valve multilayers of the general type:
 FeMn/Ni80Fe20/Co/Cu/Co/Ni80Fe20 on glass and aluminium oxide substrates by
 scanning tunneling microscopy (STM). The two substrates give very similar
 results. These polycrystalline **GMR** multilayers have a tendency to exhibit larger
 grain size and increased roughness with increasing thickness of the metal layers.
 Samples deposited at a low substrate temperature (150 K) exhibit smaller grains
 and less roughness. Valleys between the dome-shaped individual grains are the
 dominant form of roughness. This roughness contributes to the **ferromagnetic,**
 magnetostatic **coupling** in these films, an effect termed 'orange peel' coupling by
 Neel. We have calculated the strength of this coupling, based on our STM images,
 and obtain values generally within about 20% of the experimental values. It
 appears likely that the **ferromagnetic coupling** generally attributed to so-called
 'pinholes' in the Cu when the Cu film thickness is too small is actually 'orange
 peel' coupling caused by these valleys.
CT COBALT; COPPER; FERROMAGNETIC MATERIALS; GIANT MAGNETORESISTANCE; GRAIN
 SIZE; IRON ALLOYS; MAGNETIC MULTILAYERS; MAGNETIC PARTICLES; MAGNETOSTATIC
 WAVES; MANGANESE ALLOYS; METALLIC SUPERLATTICES; NICKEL ALLOYS; SCANNING
 TUNNELLING MICROSCOPY; **SURFACE TOPOGRAPHY**
ST orange peel coupling; surface roughness; grain size; giant
 magnetoresistance; spin valve multilayers; scanning tunneling microscopy;
 substrate temperature; magnetostatic coupling; **ferromagnetic
 coupling;** film thickness; 150 K; FeMn-Ni80Fe20-Co-Cu-Co-Ni80Fe20